

P.O. Box HM 506 Hamilton, HM CX Bermuda

Tel: (441) 295-8080 Fax: (441) 296-0560

July 2, 2018

Ms. Monique Lister Regulatory Authority 1st Floor, Craig Appin House 8 Wesley Street, Hamilton, HM 11 By Hand and By Electronic Filing

2 JUL '18 PM1:40

Response to Consultation Document: Comments on Integrated Resource Plan Proposal Consultation

Dear Madame,

As you may be aware, Bermuda General Agency Ltd. ("BGA Ltd.") is the exclusive GSA for Seabased AB in the Caribbean and the surrounding islands. Seabased AB is based in Sweden and has over some 15 years developed the world leading wave energy solution, in close cooperation with the Swedish Energy Agency, Fortum (leading Nordic utility company) and Uppsala University, a world-renowned university with the world's largest wave energy engineering department.

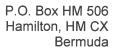
We believe that a wave energy park in Bermuda will be the ideal solution to drive down the cost of energy on our Island, while reaching Bermuda's goal for the percentage of energy usage generated by renewable and environmentally friendly

Our desire to reduce the cost of living, visiting and conducting business in Bermuda, and to improve and protect our unique environment, is so strong that we are proposing to build a privately financed wave energy park in Bermuda that not only will reduce the price of electricity to the end user, but will not burden the tax payers with significant and unpredictable capital expenses and undue risks. Accordingly, we have submitted comments to the Integrated Resource Plan below.

We stand ready to further answer any questions and bring experts to the island for further consultations.

Sincerely,

Wendall Brown, Chairman





Response to Consultation Document: Comments on Integrated Resource Plan Proposal Consultation

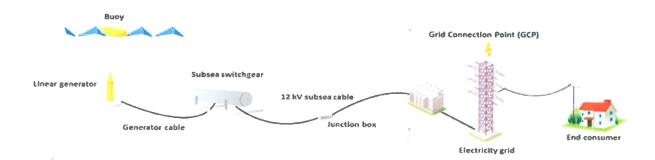
We refer to the Integrated Resource Plan (IRP) Proposal Consultation of 2nd May 2018, Consultation Questions, question number 4; "Are there alternative scenarios not included in the IRP Proposal, which may provide for an electricity generation mix that is more consistent with the purposes of the EA?", and would like to provide our comments to Section V paragraphs 49 and 50 in the Consultation Document as per the following:

It is our firm belief that wave energy could be built up into a perfect fit for Bermuda, fulfilling essentially all the critical requirements that Bermuda Electric Light Company Limited needs to consider in the long term. It is, furthermore, our opinion that wave energy generation can contribute substantially to an electricity supply that is well consistent with the purposes of the Electricity act and ministerial directions.

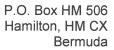
Consequently, we respectfully request that wave energy is considered as a Renewable Fuel Resource and part of the renewables mix Bermuda includes in its IPA / resource plans. The Bermuda wave climate is particularly good, which, together with the existing infrastructure can make a wave power generation facility financially very viable.

Wave Technology

In essence, the proposed Seabased wave energy technology works like this: Buoys connected to linear generators (wave energy converters, or WECs) move with the waves, and this motion generates power. A subsea switchgear makes the electricity suitable for grid use, and sea cables deliver it to the grid.

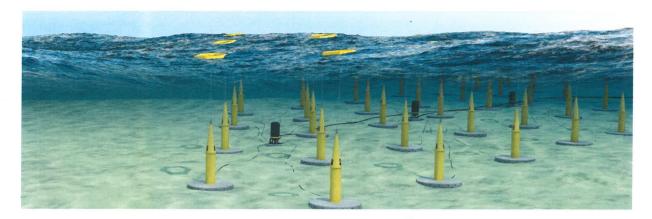


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Seen from underwater, a Seabased wave park could look something like this:



For more information, please refer to the attached presentation of the company, as well as their website, www.seabased.com

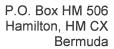
Wave Energy Strengthens the Electricity Act (EA)

The following purposes of the Electricity Act (ref section 6) can be directly strengthened by including wave energy in the energy mix for Bermuda:

- to promote the adequacy, safety, sustainability and reliability of electrical supply in Bermuda so that Bermuda continues to be well positioned to compete in international business and global tourism markets;
- to promote the use of cleaner energy sources and technologies, including alternative energy sources and renewable energy sources;
- to protect the interests of end-users with respect to prices and affordability, and the adequacy, reliability and quality of electrical service; and
- to promote economic efficiency and sustainability in generation, transmission, distribution and sale of electricity.

With regards to the economic interests of end-users, economic efficiency and reliability, and Bermuda's competitive edge for international business and global tourism, the proposed Seabased Wave Energy technology is price competitive and can help lower electricity prices for businesses, tourists and the population in general.

With significantly lower cost than brown energy alternatives such as diesel, and given the good fit with the wave climate of Bermuda, wave power can offer a very good long-term solution for the Island's energy needs.





Our very preliminary feasibility study indicates there are several promising sites for a wave energy park; see the illustration below, where three possibilities have been identified for further consideration, of which B3 could potentially be the most interesting. Although substantially more work must naturally be carried out, we believe that an installation of a potential 20 MW park, which can be operational within approximately 18 months of order placement, would be quite feasible.



Taking into account variables for CAPEX for the installed and grid-connected the park, anticipated OPEX, and an anticipated expected delivery to the grid assuming a system capacity factor of 30-35%, we expect LCOE will be between USD 0.08 and 0.14 per kWh.

Our understanding of figure 1.1 of the Belco IRP proposal is that island's electricity needs are projected to be approximately 615 GWh/ year for the coming decade and beyond. This means that the 55- 62 GWh/year our preliminary studies estimate a 20MW Seabased wave power park would deliver to the grid, providing enough electricity to meet some 9-10% of the island's annual electricity needs. This would have a substantial positive effect in lowering the carbon in all 4 scenarios by 9-10%.

Even the conservative estimate of 14 cents per kWh for 55 GWh/ year, or 9% of total production, would have a positive effect in lowering both the average LCOE of all 4 scenarios presented in Table 2-1 of the proposed Belco IRP (below), which ranges from 16.8 to 17.2 cents per kWh.



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Fax: (441) 296-0560

Table 2-1
Summary of Estimated Levelized Cost by Scenario (\$/MWh)

Scenario	Levelized Cost (\$/MWh)	Difference from Scenario 1 (\$/MWh)	Difference from Scenario 1 (%)
Reference (Scenario 1)	170.80		
Fuel Oil + DSM + Renewables (Scenario 2)	168.08	(2.72)	(1.6)%
NG + DSM + Renewables (Scenario 3)	174.87	4.07	2.4%
LPG + DSM + Renewables (Scenario 4)	169.99	(0.80)	(0.5)%

Seabased's wave technology can also provide a reliable source renewable electricity to the grid. By nature, wave power is far less intermittent than wind and solar, and waves can often provide a base load to the grid without the use of expensive batteries. Waves are very predictable, usually between 5 days and 2 weeks in advance; this makes it easier for utility companies to plan the appropriate mix to meet anticipated demand.

The reliability of electrical supply from waves can also be approached from the perspective of storm survivability. Seabased technology has been rigorously tested to handle storms and extreme waves in the Plymouth test tank (ref. incl *Peak Forces on Wave Energy Linear Generators in Tsunami and Extreme Waves*, Sjøkvist L, 2017); in addition, the system was able to handle storms with more than 6 meter waves at the demonstration park in Sotenäs, Sweden.

From a price perspective, wave energy is also reliable: Unlike oil prices, which are subject to an international market, the local plant will be providing power from local waves according to some form of a PPA, and as such will be quite predictable.

The CAPEX and OPEX of the suggested 20 MW wave park would be privately funded and hence relieve the taxpayers of any undue risk and/or unpredictable expenses. The utility company (and end user) would simply pay for the electricity provided to the grid according to a PPA.





With regard to promoting Bermuda's competitive edge in international business and global tourism, Seabased's wave energy technology has several distinct advantages over many renewables, including that it does not create eyesores, does not create noise disturbance, has no moving parts that harm animals, and it requires extremely little land area.

Seabased wave parks are almost invisible. As only the buoys break the surface, rising up about 1 meter, they are only visible from short distance, and the park will likely not be visible from shore even in calm weather.

The wave parks do not repurpose valuable commercial real estate. They require only a small amount of land area for the land switchgear and the grid connection. The cable connected between the wave park and the land switchgear is buried / hidden.

The picture below illustrates a Seabased wave park as visible from land:



Compare with the classic view of a solar park:







We refer to the table below for a more complete comparison of wave energy to wind and solar technologies.

TECHNOLOGY COMPARISON, WAVE WIND AND SOLAR

Technology	Category	Capacity Utilization	Needs Batteries	Start-up	Transmission Losses	Noise
Seabased Wave	Can provide a base load	25% - 70%	No	Self-starting	Minimal; site usually close to end users	Minimal, under water
Offshore Wind	Intermittant renewable	30% - 45%	Yes	Batteries	Can be significant due to distance	Yes
Onshore Wind	Intermittant renewable	18% -35%	Yes	Batteries	Can be significant due to distance	Yes
Solar PV	Intermittant renewable	11% - 21%	Yes	Self-starting	Varies; requires constant cleaning	No
Technology	Animal Safety	Land Area Use	Eyesore	Cradle to C	radle Aspects	Other Advantages
Seabased Wave	No moving parts that harm animals; creates artificial reef & "no take zone"	Land connection/ grid connection only	Almost invisible until very close	materials;	own, well-tested much can be no toxic waste	Modular system, creates artificial reef for marine life; no corrosion
Offshore Wind	Blades can harm large migrating birds	Land/grid connection only	Some think so, but often far out at sea	Batteries requ	uire safe disposal	Turbines up to 4 MW each
Onshore Wind	Blades can harm large migrating birds	Significant	Some think	Batteries requ	uire safe disposal	Well-established technology
Solar PV	Large installations can create issues for	Significant save	Depends	PV tech requ	iires safe waste	Well-established





With regard to promoting the use of cleaner energy sources and technologies, including alternative energy sources and renewable energy sources, Seabased's Wave Energy technology is among the cleanest sources of renewable energy available.

Because it is a renewable, 20 MW of Seabased wave energy would positively impact the percentage of renewables in the scenario mixes in tables 2-3 to 2-5 of the proposed Belco IRP, increasing the total percentage of electricity from renewables from about 18.3% to approximately 27% - 28% in 2023.

Given that there are zero emissions, the Carbon Emissions Scenario in Figure 2-3 of the proposed Belco IRP (below) would be reduced by 9-10%.

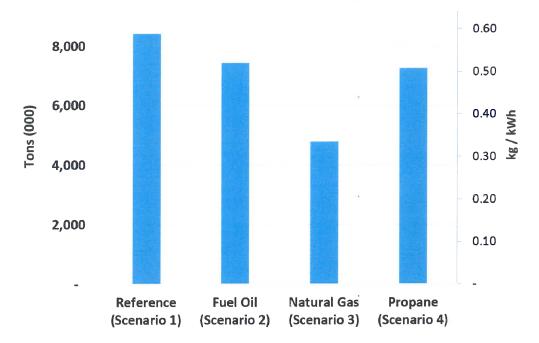
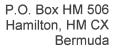


Figure 2.3 – Summary of Carbon Emissions by Scenario During Study Period

There are no emissions from the operational wave power park that could damage surrounding flora or fauna. There are no underwater moving parts that could harm animals. The Seabased solution uses an electromagnetic generator that does not involve hydraulics that require oils that pollute.





A positive side effect of Seabased wave parks is that they create artificial reefs for a wide variety of animals (ref. incl Wave and Tidal Range Energy Devices Offer Environmental Opportunities as Artificial Reefs, Callaway R, 2017). As no fishing or trolling is allowed, the area around the wave park is comparable to a marine wildlife refuge. Seabased can add design details to the base plates to make these reefs more attractive to local marine life – such as holes for crabs and other sea animals.

Marine growth, such as seaweed and barnacles, is expected to occur. Rather than depending on regular cleaning to function properly, Seabased wave parks are designed to be enjoyed by the local flora and fauna.

Seabased technology can help Bermuda achieve its environmental quality objectives. This is the case in the technology's home country of Sweden, whose environmental policies and regulations are considered guite advanced. In addition to supporting the seventeen UN Sustainable Development (SDGs), (www.un.org/sustainabledevelopment/sustainable-development-goals/) Swedish the established environmental objectives Parliament has sixteen (www.naturvardsverket.se/Documents/publikationer/978-91-620-8324-3.pdf). As far as they concern wave power, these objectives provide the guideline for all Seabased activities. This was also commented upon by the Swedish Energy Agency in their decision to support the Sotenäs wave power project, dated 2010-02-11, Attachment 1, as follows (translated from Swedish);

"The project has an impact on the environmental quality objectives limited climate impact, fresh air and only natural acidification. Increased production of renewable energy, which also does not produce any emissions, reduces the use of fossil fuels for electricity generation, reducing emissions of sulphur and nitrogen oxides that are acidifying substances, airborne particulate pollutants and greenhouse gases such as carbon dioxide. During the operation of a commercial wave power plant, the emissions to the atmosphere are minimal and are derived exclusively from maintenance operations. Greenhouse gas emissions and other emissions are largely limited to the transport and manufacturing of components."

Numerous studies (ref incl Wave power—Sustainable energy or environmentally costly? A review with special emphasis on linear wave energy converters, Langhammer O, 2012 and Life Cycle Assessment of Electricity from Wave Power, Dahlsten H, 2009) and environmental impact assessments from the Seabased demonstration projects in Sotenäs and Ghana support these claims.





In addition, Seabased technology can have a low cradle-to-cradle (sourcing to recycling) footprint. Some 35 % of the product is steel and ferrite magnets, both of which are subject to established manufacturing practices that can be environmentally certified, and are easily recyclable. The bulk of the remainder (or some 60 %) is concrete which, when broken up, is generally suitable for landfill.

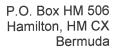
The use of local content for production and assembly (i.e.: cement baseplates, buoys and steel casings for the generators) can both create local jobs and significantly reduce the environmental footprint of shipping.

Seabased's end-of-life decommissioning projections suggest that around 95 % of all material used can be recycled or is suitable for landfill. This is in contrast to PV solar cells, which require highly specialized recycling due to their toxic substance content.

Commercial Readiness of Seabased Wave Technology

Seabased AB holds some 100 patents in 20 patent families for their wave power technology, and over 20 PhDs have been done on various aspects of the technology. Seabased has been testing its generators in ocean environments since March of 2006. The trials have been carried out across all 4 seasons at 5 different sites in 4 different countries. The system has withstood both 15 cm of floating ice (Åland) and storm waves of over 6 meters (Sotenäs).

Seabased technology successfully tested their first generator at full-scale in an ocean environment in 2006 (ref incl: Wave Energy from the North Sea: Experiences from the Lysekil Research Site, Leijon M,2008). They progressed to testing 3 generators tested in parallel in 2009 (ref incl: Experimental results from the operation of aggregated wave energy converters, Rahm M, 2012) to trials in all four seasons in the Baltic Sea, where with exception of a few hours when a buoy was changed, the Seabased generator ran continuously and without issue for 450 days (approximately 10800 hours) from 25 September 2012 until the planned end of the project, 19 December 2013. (ref incl: Study of the operation characteristics of a point absorbing direct driven permanent magnet linear generator deployed in the Baltic Sea, Lejerskog E, 2016)





From there, commercial preparations focused on multi-generator demonstration parks in Ghana (Ada) and in Sweden (Sotenäs). The projects encompassed permits, environmental and feasibility studies, the engineering and design of the park, the procurement and in many cases in-house manufacture of all components, the development of quality, safety and testing procedures, and the delivery, installation and grid connection of the entire park.

TC's Energy of Ghana developed a pilot project with Seabased in 2014-2016 which forms the basis for our current contract to further build out a 100 MW wave power plant near Ada, Ghana. (www.seabased.com/100mwcontractghana)

The pilot was initiated in order to learn how to quickly and economically scale up assembly and installation so that Seabased and TC's Energy could successfully install a 1000 MW wave park using local content to the greatest extent viable. Seabased wanted to explore what aspects of assembly, testing and installation could be done in Ghana, and what circumstances / conditions make this efficient in terms of quality, price and speed, so these lessons could be applied to the 1000 MW wave park.

Seabased was responsible for supplying a complete wave power plant consisting of 6 L12 WEC generators, one connection hub, land switchgear and the sea cable. Seabased's responsibility included design, manufacture or procurement, and delivery to Ghana, as well as supervision of installation and testing.

The scope of the Sotenäs demonstration park (<u>www.seabased.com/sotenaes</u>) included manufacture and installation of 36 wave energy converters (WECs) and one subsea switchgear (LVMS), and the installation of an almost 10 km long transmission link between the wave energy park and the mainland grid.

The Low Voltage Marine Substation (LVMS) became what is believed to be the world's first grid-connected subsea generator switchgear. The subsea station was necessary for this project due to the long distance between the park and the grid.

The 36 generators, LVMS and electrical system were installed during 2015 and on 14 January 2016, Seabased successfully connected the first buoys to their respective generators. At that point, the wave park began generating to the Nordic Electricity Grid, The event received widespread international attention, heralded as the first grid-connected multi-generator wave park in the world.

Notable successes include that the wave energy converters (WECs) generated more power than anticipated, especially in lower wave heights.



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The Sotenäs project was the result of a partnership between Seabased, Fortum, and the Swedish Energy Agency. The Swedish Energy Agency awarded a 45% investment grant to Seabased for the wave power plant.

In summary, an increased use of wave power technology will bring with it a whole range of benefits from the environmental perspective, benefits that are highly valued by both the market and by environmentalists. The impact on environmental goals such as reduced climate impact, improved air quality and reduced natural acidification will be far reaching. By reducing the use of fossil fuels for the generation of electric power, greenhouse gas emissions, acidifying substances and airborne particulate pollutants will be reduced.

In closing, we want to reiterate our strong belief and interest in moving a wave energy project forward in Bermuda; we thank the RA for the attention, and stand ready to provide availability of the relevant expertise for follow-up consultations and further feasibility studies. Please contact Mr. Wendall Brown at BGA Ltd. for further coordination.

Sincerely,

Ple: Wendall Brown, Chairman

Attachment (By Hand): Seabased – Company Overview



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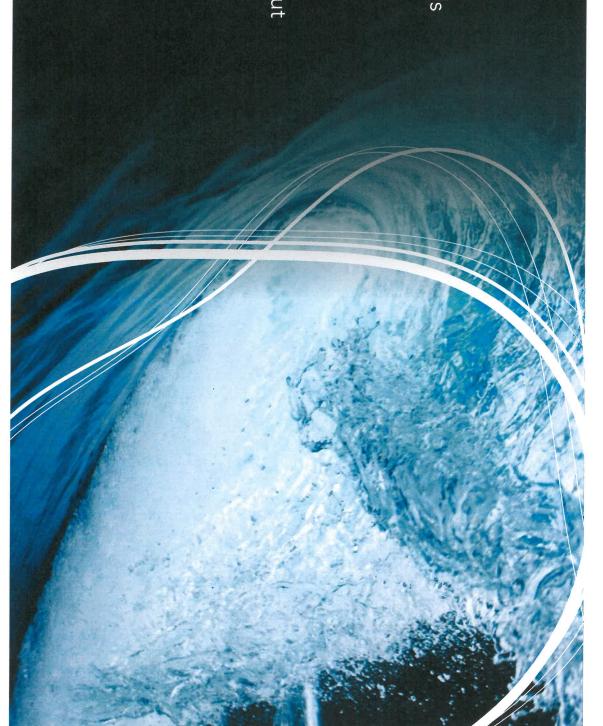
WHAT WE DO

Seabased designs, builds and installs complete turnkey wave parks.

We offer affordable renewable energy without creating eyesores or requiring land area use.

In the process we can create local jobs.



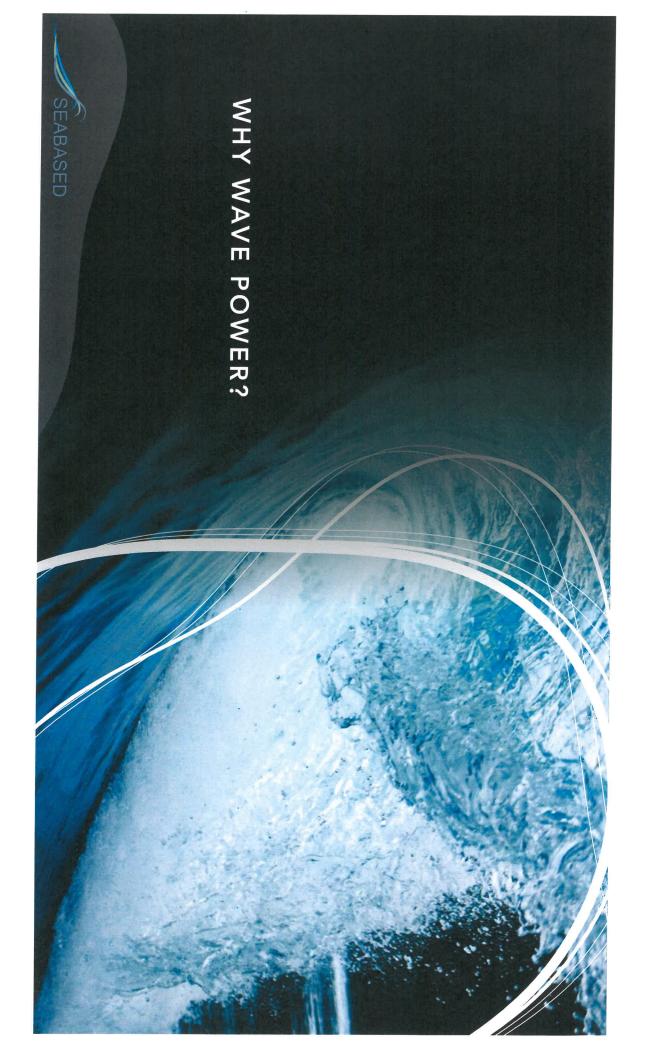


WHY WE DO IT

dreams with affordable, renewable electricity. We believe in abundance. We believe you should dream big, and power those

people, planet, and profit. We love the challenge of creating technical solutions that create a triple win for





WHY WAVE POWER ADVANTAGES OF SEABASED WAVE POWER

Stable Availability of Energy

= Predictable Base Load

Minimal Need for Batteries

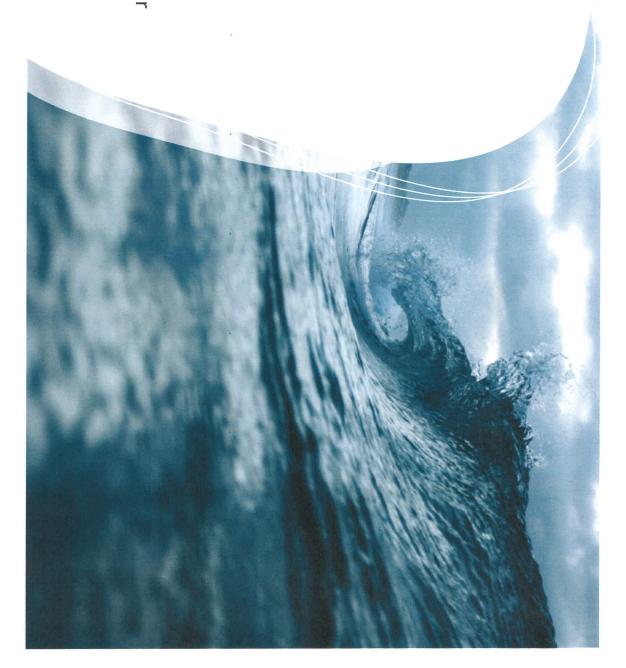
Small Footprint = More Power per M2

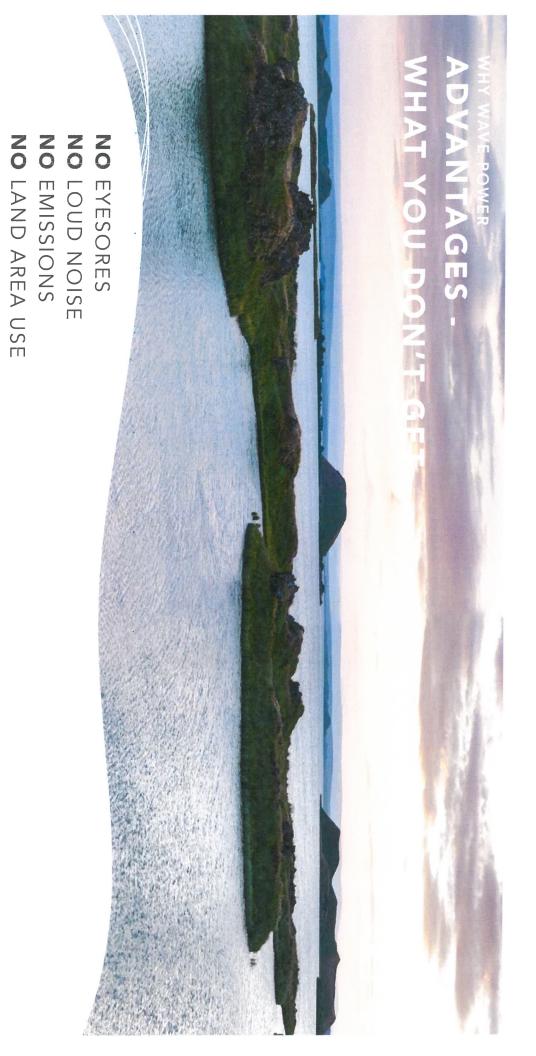
Close Proximity to End Users

= Minimal Transmission Cost

Can Withstand Extreme Weather







NO OILS THAT POLLUTE NO MOVING PARTS THAT HARM ANIMALS

SEABASED

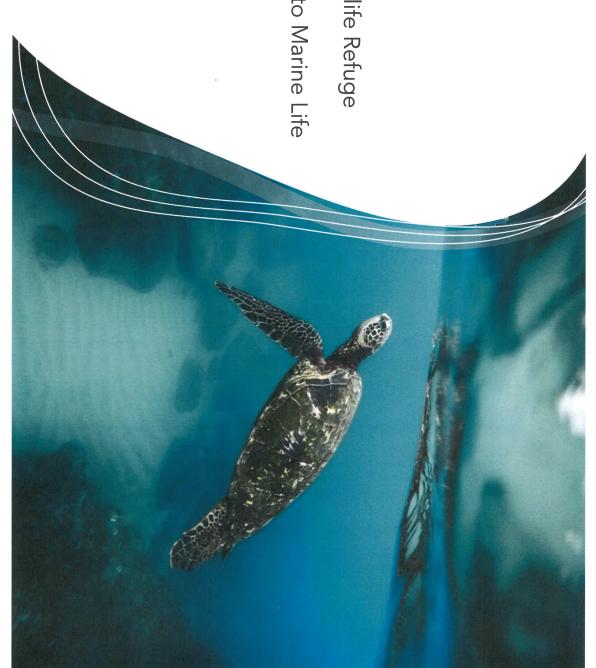
GENTLE ON THE ENVIRONMENT

Artificial Reef / Marine Wildlife Refuge

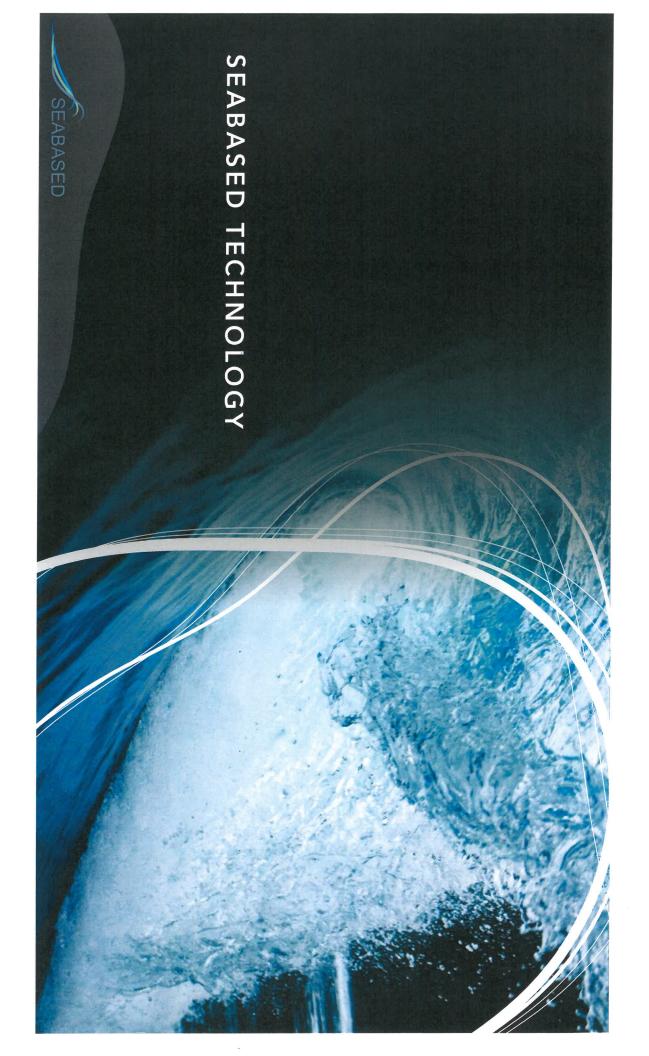
Design Details → Attractive to Marine Life

No Cleaning Needed





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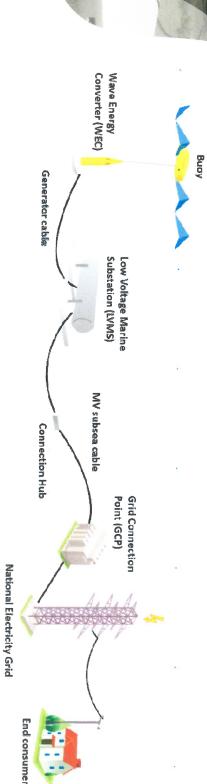


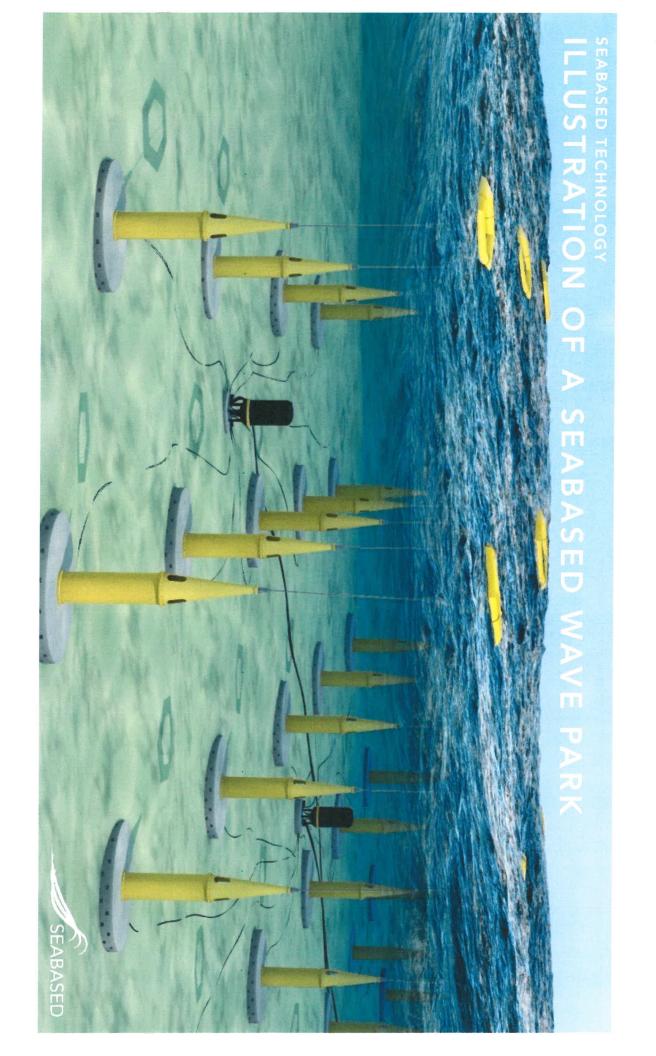


SEABASED TECHNOLOGY

SEABASED TECHNOLOGY BASICS

sea cables deliver it to the grid. WECs) move with the waves, and this motion generates power. Buoys connected to linear generators (wave energy converters, or A subsea switchgear makes the electricity suitable for grid use, and





SEABASED TECHNOLOGY

TECHNICAL SPECIFICATIONS S2.7 WEC

OPERATING DATA

Rated power Cut in wave height 0,3 m 100 kW

Cut out wave height Z

Sound level 50 dB

Installation depth 20 - 35 m

ELECTRICAL

Seabased linear, direct driven generator

Subsea inverter, subsea transformer,

Grid feed Generator

land switch gear

Control sytem Seabased SCADA

50/60 Hz AC

Power output

DRIVE TRAIN

Force transportation

Rotational free steel line

REGULATION

Brake system Power regulation

Electrical & mechanical Electrical regulated

DIMENSIONS & WEIGHT

Generator height

Generator diameter

Generator weight 20 t

Buoy height 23

Buoy max width **Buoy** weight 6.1 m

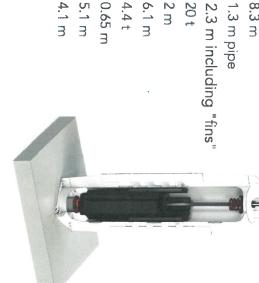
4.4 t

5.1 m 0.65 m

Base plate height

Base plate width Base plate length

4.1 m





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SEABASED AT A GLANCE

World's First Multi-Generator Grid Connected Wave Park

World's First Grid Connected Subsea Generator Switchgear

Approx. 4.5 Years of Generator Run Time

Founded 2001 by Dr. Mats Leijon

More than:

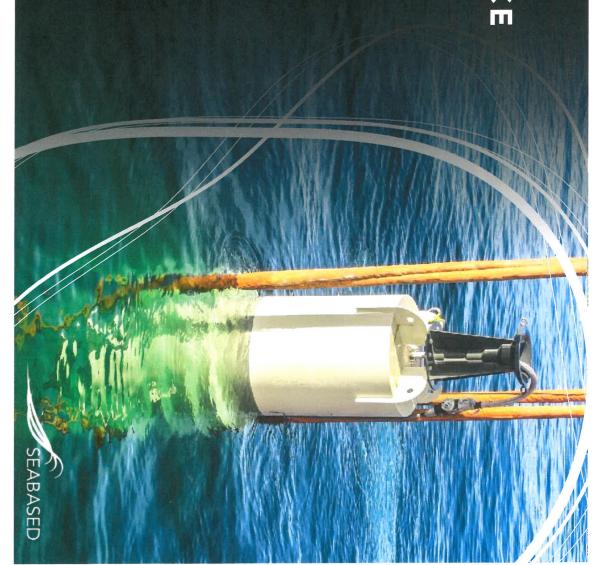
- 100 Patents
- 20 PhD Theses

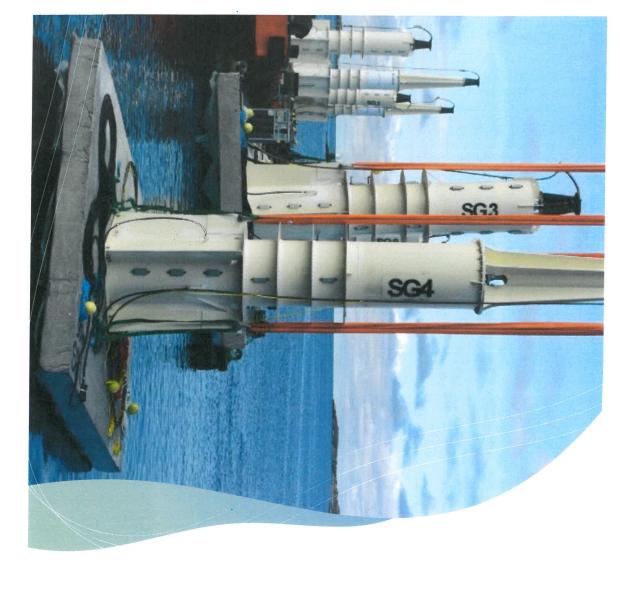
Close cooperation with Uppsala University

About 30 employees today

Operational factory in Lysekil since 2010

Now expansion of production in Norway...





SEABASED TECHNOLOGY

SEABASED TECHNOLOGY ADVANTAGES

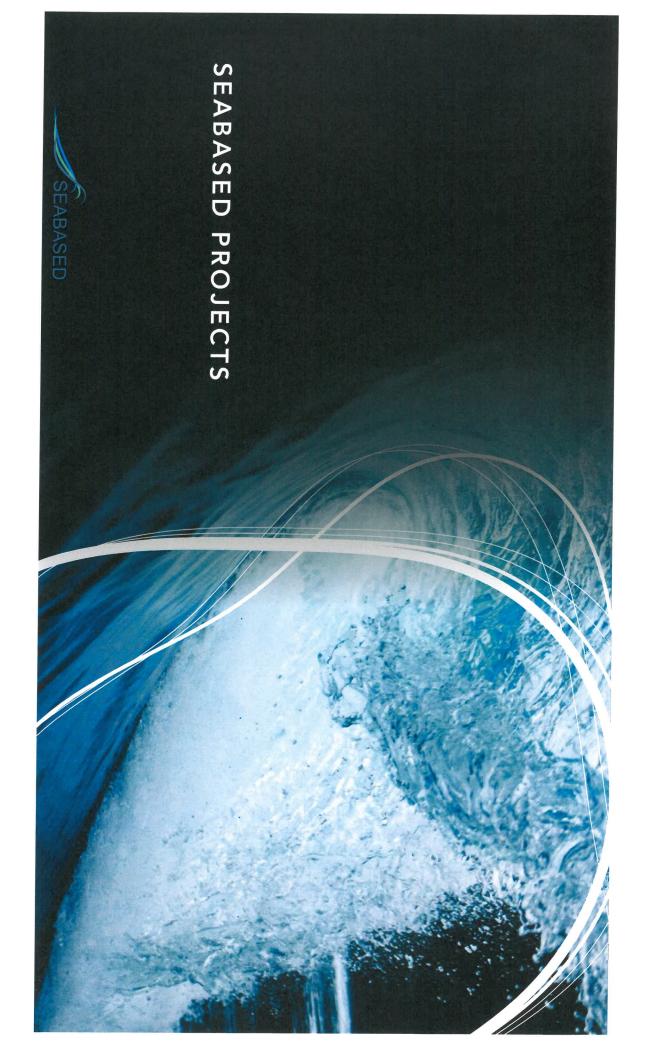
Simple, robust, reliable

Operates 24/7/365 Survives storms

Modular

Cost-competitive

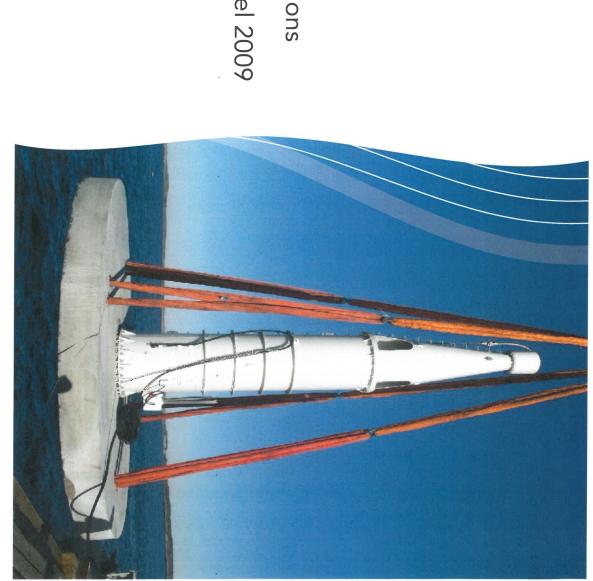




UPPSALA UNIVERSITY

Islandsberg, Sweden (Uppsala U)

- •L1: March 2006 (2 mos)
- 12 generators and 2 substations
- 3 generators tested in parallel 2009







SEABASED PROJECTS

PROVING THE TECHNOLOGY IN AALAND

Project WESA: full-scale sea trials of a Seabased WEC in all four seasons in the Baltic Sea

Experiments conducted with two buoys, including an ice buoy

WEC ran 450 days (approx. 10 800 hours) (switched buoys 1x)

Survived drifting ice fields up to an ice thickness of 15 cm



THE GHANA PILOT PROJECT

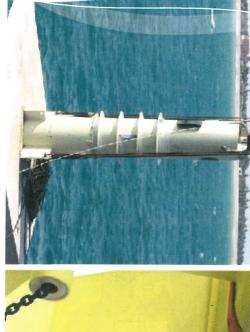
wave park just south of Ada, Ghana, for completed a pilot project for a 400 kW TC's Energy. In 2016 Seabased successfully

scale up assembly and installation. primary purpose of the pilot was to This is Africa's first wave power plant. A learn how to quickly and economically

and PPA are all in place contract to deliver 100 MW to TC's On 20 March 2018, Seabased signed a Energy. The necessary studies, permits









THE SOTENÄS PROJECT

World's First Grid Connected Multi-Generator Wave Park

- 13 December 2015: Connected subsea multigenerator switchgear (LVMS) to grid.
- the Nordic power grid for the first time thewave energy park generated electrical power to 14 January 2016: First buoys connected and
- 36 WECs deployed
- WECs generated considerably more power than anticipated, especially at low wave heights
- The system was able to withstand waves over 6 meters
- Nov 2017: Fortum becomes approx. 9% shareholder in Seabased









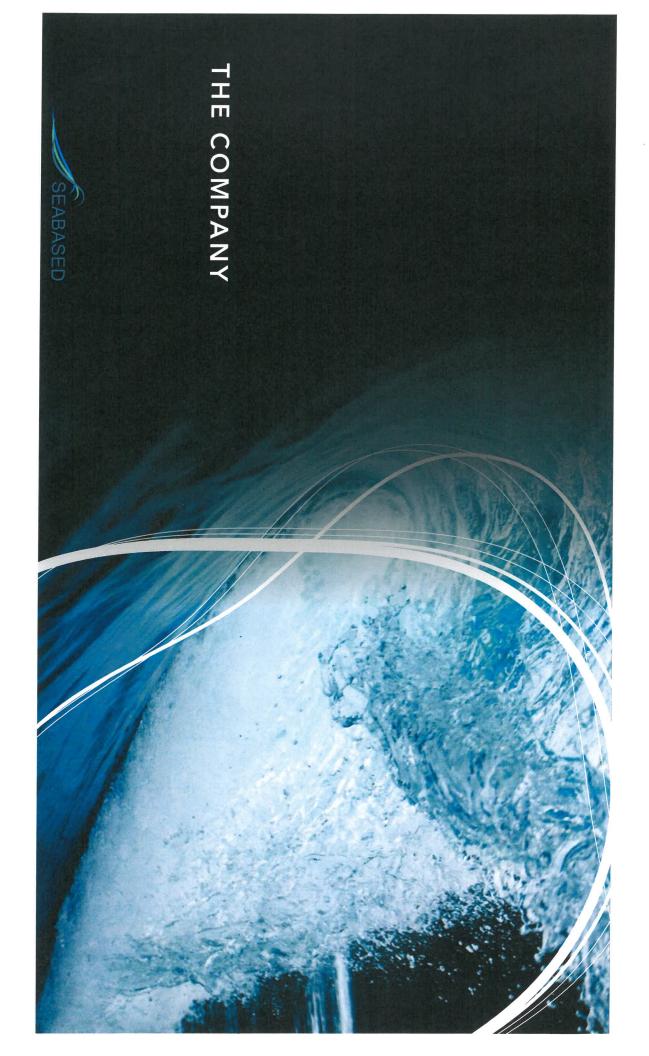
TURNKEY FROM BUOY TO GRID

Seabased's hands-on experience with delivering a turnkey wave park includes:

- Permit processes
- Feasibility studies
- wave parks from buoy to grid Engineering and design of the complete
- Scaled-up production of our WECs and buoys
- Localized final assembly
- Installation of the entire wave park, including buoys, generators and electrical system







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THE COMPANY

Collaborative culture with the best of 3 worlds:

- World class academia
- Swedish industry
- Norwegian subsea and installation knowhow

 high quality, innovative yet practical solutions that can be upscaled cost-effectively

SEABASED



THE RESEARCH

Close cooperation with Sweden's prestigious Uppsala University since 2001

Over 20 PhD thesis have been written about our technology.

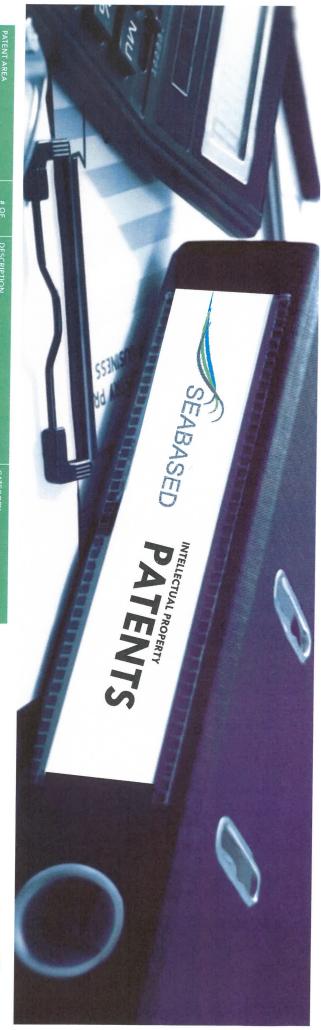
Collaboration with many universities including

- Plymouth & Southhampton (UK)
- Oregon State (US)
- Nantes in (FR)
- Lisbon (PT)
- NTNU in (NO)
- Several EU and EIT projects





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	PATENTS	DESCRIPTION	CATEGORY
Patents regarding the General System Design	ω	Systems for Generating Electrical Energy	General System Design
Patents regarding the General Converter (Wave Power Unit)	ω	Wave Power Units, and use of such	General Converter Design
Patents regarding the General Electric System	-> ->	Electric Device and Method for a Wave Power Plant Wave Power Unit	Power Electronic Circuit Secondary Electric Connection
Patents regarding the Mechanical Protection	2 -	Wave Power Units Wave Power Assembly	Implementation of Rubber Design Detail Patent: End stop design
Patents regarding the Selling and Guidance System	ω → ν	Wave Power Units Linear Generator for Submerged Use Wave Power Units, incl w/ Guiding Device	Detail Patent: Sealing System Detail Patent: Internal Sealing Detail Patent: Guidance System
Patents regarding the Stator Design	№ →	Stator Frame for Submerged Linear Generator Wave Power Units, incl w/ Linear Generator	Detail Patent: Stator Design Detail Patent: Stabilisation System
Patents regarding the Buoy Design	_	Wave Power Unit	Detail Patent: Buoy Design

Detail Patent: Buoy Design

THE PATENTS



as well as components. It's comprised of more than 100 patents currently in use in Seabased Wave Parks. multiple jurisdictions worldwide. These include the patient in some 20 patent families that are protected in written patents for the entire system from buoy to grid, Our very comprehensive portfolio of unique, broadly

THE CURRENT FACTORY

- Lysekil, Sweden
- Started production in 2010
- June 2018: 30+ employees
- Workshop facilities: 4000m2
- Office and personnel facilities:
 710m2
- Deep integration facility







